REMARKS

In view of the foregoing amendments and following remarks responsive to the Office Action of October 24, 2003, Applicant respectfully requests favorable reconsideration of this Application.

Objections and Rejections as to Form

The Office objected to claim 2 because it lacked a period at the end of the claim. An appropriate correction has been made herein.

The Office further rejected claim 18 under 35 U.S.C. §112, second paragraph, as being indefinite in that there is insufficient antecedent basis for the term "wherein said fixed voltage is analog ground". Applicant has herein amended claim 18 to refer to "said voltage source" rather "said fixed voltage" in order to remedy this problem.

Prior Art Rejections

The Office further rejected claims 1-6, 9-11, 27-32, and 34-35 under 35 U.S.C. §102(a) as being anticipated by Applicant's admitted prior art. The Office further rejected claims 7, 12, and 33 under 35 U.S.C. §103(a) as being unpatentable over the admitted prior art in view of Scott; claims 8 and 13-17 under 35 U.S.C. §103(a) as being unpatentable over the admitted prior art in view of Scott as applied to claims 7 and 12 and further in view of Yong; and claims 19-26 under 35 U.S.C. §103(a) as being unpatentable over the admitted prior art in view of Scott and further in view of Jamshidi.

Applicant respectfully traverses the prior art rejections.

The Present Invention

The many pieces of equipment that use the telephone lines for communication include circuitry for determining whether the telephone line to which it is coupled is off-

hook prior to attempting to use that line. It is necessary because it is often the case that another piece of equipment may already be using the same line. In the past, dedicated circuitry for determining an off-hook condition of the line has been incorporated into such equipment.

In the past, telecommunication equipment manufacturers have utilized voltage comparator circuits to detect the DC voltage across the tip and ring of the subscriber loop and then used the comparator output as an on-hook/off-hook indicator signal.

The present invention provides a low-cost simple circuit that utilizes a low power analog-to-digital converter that already is incorporated into the telecommunication device and used for other functions, such as caller ID and ring detection, thus reducing the amount of hardware that is added for the sole purpose of detecting on-hook/off-hook status. In one embodiment of the invention, the only additional dedicated circuitry necessary to implement the invention is a voltage divider coupled to tip and ring and a transistor having its control input coupled to the common node of the voltage divider, one of its current flow terminals coupled to the analog input of the analog-to-digital converter, and the other current flow terminal coupled to ground. The resistors of the voltage divider are proportioned so that the common node voltage of the divider is above the threshold voltage of the transistor when the voltage request tip and ring is at the on-hook voltage (approximately 48 volts in the United States), thus turning the transistor on; and is below the transistor threshold voltage when the voltage across tip and ring is at the off-hook voltage (approximately 20 volts in the United States), thus turning the transistor off. With this scheme, when the transistor is on, the A/D converter input is driven to ground, thus keeping the voltage at the common node of the voltage

divider from having any effect. When the transistor is off, however, the A/D converter input is driven to the common node voltage of the transistor. Accordingly, when the transistor is off, the digital output of the A/D converter is an indication of the voltage on the telephone line and thus whether it is on-hook or off-hook. The output of the A/D converter can be coupled to a digital signal processor that disables the device from going off-hook if the A/D converter detects that the loop is already off-hook.

In an alternate embodiment, the voltage across one of the resistors of the voltage divider is provided to the A/D converter through the current flow terminals of one or more transistors so that the A/D converter receives a scaled version of the tip to ring voltage (rather than merely a two-state on-hook/off-hook signal, as in the first embodiment). The DSP may use the specific line voltage information provided in this particular embodiment to determine additional information about the loop.

The Admitted Prior Art

The admitted prior art is shown in Figure 1 and comprises a voltage divider coupled between tip and ring with the common node of the voltage divider coupled to a first input of a comparator. The second input of the comparator is coupled to a reference voltage somewhere between the typical on-hook voltage and the typical off-hook voltage. The output comparator is fed through an optical coupler to the DSP, which uses the output comparator as an indicator of whether the line is on-hook or off-hook. The optical coupler is necessary because a less expensive electrical coupling circuit, whether inductive or capacitive, would not function well in this application

because the signal cross tip and ring can change too slowly to be distinguished from noise by an electrical coupling circuit.

Response to Rejections

Claim 1 as amended recites a circuit for detecting off-hook condition comprising a voltage divider coupled to tip and ring, a transistor with its control terminal coupled to the common node of the voltage divider, and A/D converter with its analog input coupled to one of the current flow terminals of the transistor.

Applicant has herein amended claim 1 to add the analog-to-digital converter. In accordance with this change, Applicant has cancelled claim 3.

Clearly, the prior art circuit disclosed in Figure 1 is very different than the invention as embodied, for instance, in the circuit shown in Figure 3. The differences are so apparent that Applicant assumes that they are clear to the Office, and that the pertinent issue is that the Office deems the claim language to be insufficiently specific to distinguish over the admitted prior art.

In its rejection, the Office attempts to read the admitted prior art (Figure 1 of the present application) on the claimed invention by taking the positions that the optical coupler in Figure 1 comprises the claimed transistor and that the comparator in Figure 1is essentially an analog-to-digital converter because it receives an analog input and has a bi-stable (i.e., digital, according to the Office) output.

Applicant respectfully traverses. There are at least two flaws in the Office's analysis. First, a comparator is not an analog-to-digital converter simply because it has a bi-stable output. The term "analog-to-digital converter" is well defined in the related

arts and does not comprise a comparator. Secondly, even if the comparator is considered an analog-to-digital converter, the circuit disclosed in Figure 1 nevertheless still would not meet the limitations of claim 1. Particularly, claim 1 recites that the transistor is coupled between the voltage divider and the analog-to-digital converter. However, Figure 1 discloses a circuit in which the optical coupler (the alleged transistor) is positioned after the comparator (the alleged analog-to-digital converter).

Specifically, referring to the language of amended claim 1, it recites that the analog input of the analog-to-digital converter is coupled to the second current flow terminal of the transistor. This would not be the case in Figure 1, even if the optical coupler is considered to comprise a transistor and the comparator is considered to comprise an analog-to-digital converter. Accordingly, claim 1 clearly distinguishes over the admitted prior art. Claims 2 and 4-8 depend from claim 1 and, therefore, distinguish over the prior art for at least the same reasons set forth above with respect to claim 1.

Independent claim 9 recites a similar distinguishing feature. Particularly, independent claim 9 also recites that the analog input of the analog-to-digital converter is coupled to the second current flow terminal of the transistor. Accordingly, claim 9, as well as dependent claims 10-18, distinguish over the prior art of record for the same reasons discussed above in connection with claim 1.

Independent claim 27 claims the present invention in a different style. Particularly, it is a method claim that recites the steps of (1) modulating the DC voltage across the tip and ring lines, (2) passing the modulating DC voltage "through an electrical high voltage interface circuit", and (3) determining whether the line is off-hook as a function of the modulated DC voltage. The important thing to note about this claim

is that it claims the fact that the present invention eliminates the need in the prior art circuit for an optical coupler between the off-hook detection circuit and the DSP. As noted above, in the prior art, a high voltage coupling circuit, such as the optical coupler shown in Figure 1, was necessary to assure the ability to distinguish a slowly changing signal across tip and ring from noise. With respect to this key feature, the Office asserted that the comparator's output in Figure 1 is passed through an optical coupler (i.e., high voltage interface) (Figure 1, Element 28). Further, the Office has missed the fact that the claim not only recites that the interface is a high voltage interface, but that it is an electrical interface. Accordingly, the admitted prior art of Figure 1 teaches the opposite of what is claimed in claim 27. Accordingly, claim 27 clearly distinguishes over the prior art of record because the admitted prior art does not teach an electrical high voltage interface circuit and this distinction has significant advantage over the prior art, as discussed above.

Claims 28 through 35 depend from claim 27 and, therefore, distinguish over the prior art of record for the same reasons given with respect to claim 27.

The dependent claims recite further distinguishing features over the prior art. For instance, claim 7 depends from claim 6 and adds a first capacitor coupled between tip and the first analog input terminal of the A/D converter and a second capacitor coupled between ring and the second analog input terminal of the A/D converter. Claim 12 recites essentially the same features, except that it depends from claim 9 rather than claim 1. The Office rejected claims 7 and 12 as obvious over the admitted prior art in view of Scott. The Office explained that Scott teaches multiplexing an A/D converter for the purpose of reducing required hardware interfaces and that it would have been

obvious "to multiplex the use of the A/D of the admitted prior art between the TIP and RING lines and the hook detection circuitry as taught by Scott for the purpose of reducing hardware interfaces." The Office also asserted that Scott teaches a capacitor interface between TIP and RING lines and their inputs to a mux that feeds into the A/D for the purpose of blocking high-voltage DC current into the A/D and that it would have been obvious to use the capacitor interface between TIP and RING of the admitted prior art as taught by Scott for the purpose of blocking high-voltage DC currents from reaching the A/D converter.

It is well established that an obvious rejection will fail in the absence of a suggestion in the prior art to make the proposed combination. In the present case, the obviousness rejection of claims 7 and 12 fails to meet this requirement because the Office's explanation of the motivation to make the combination is based on a faulty premise. Particularly, the Office's assertion that it would have been obvious to multiplex the use of the A/D of the admitted prior art between TIP and RING and the hook detection circuitry as taught by Scott is not accurate. As previously noted, the admitted prior art does not teach an A/D converter, it teaches a comparator. However, even if a comparator is somehow deemed to comprise an A/D converter, it is an A/D converter that cannot be used in any practical sense for any function disclosed in Scott. Particularly, as noted above, a comparator has only two output values. The comparator in the admitted prior art simply could not be used as a useful A/D in the circuitry of Scott for any secondary purpose that would render it useful to multiplex its inputs. Accordingly, there is no reasonable motivation to make the proposed combination.

Dependent claim 33 also further distinguishes over the prior art of record. It depends from claim 29 and adds the step of selectively enabling said DC voltage across TIP and RING to be modulated. The Office rejected claim 33 based on the same combination of the admitted prior art with Scott and further based on the same alleged motivation to combine. That motivation to combine has been shown to be faulty. Accordingly, the rejection of claim 33 must fail also.

Hence, at least the aforementioned dependent claims even further distinguish over the prior art of record.

Turning now to claims 19 through 26, they comprise two sets of claims skewed towards (although not necessarily limited to) the second embodiment of the invention illustrated by Figure 3. The Office rejected these claims under 35 U.S.C. §103 as unpatentable over the admitted prior art in view of Scott and further in view of Jamshidi. The second embodiment differs from the first embodiment in that it provides to the analog-to-digital converter a scaled version of the actual voltage across TIP and RING, rather than a two-state signal. In that embodiment, there are two transistors with outputs coupled to the input of a differential A/D converter. The other current flow terminals of those two transistors are coupled across one of the resistors of the voltage divider.

The Office concedes that the admitted prior art does not disclose a signal line for selectively enabling the first transistor. The Office argues that Scott teaches a multiplexer having the purpose of alternatively selecting between DC hook switch detection and DC TIP and RING lines for the purpose of eliminating the need for a separate caller-ID interface and that it would have been obvious to implement a

multiplexer at the input of the A/D converter of the admitted prior art as taught by Scott for the purpose of supplying the means to connect the TIP and RING lines to the A/D converter, thus limiting the need for an extra hardware interface. The Office further asserts that Jamshidi teaches a multiplexer using pass gate logic that passes a transistor's input to its output (i.e., the input of the A/D enables the A/D to receive the scaled version of the voltage across said TIP and RING lines) when a control signal (i.e., signal line for a selectively enabling) is in the first state and blocks the input of the transistor from reaching its output (i.e., disabling the A/D so no signals are received) when the control signal is in the second state. The Office asserted that it would have been obvious to use pass gate multiplexers in the multiplexing arrangements of the admitted prior art in view of Scott for the purpose of saving area. With respect to the second transistor recited in claim 19, the Office asserted that the admitted prior art teaches connecting two lines from the voltage divider to the input of the A/D and that using the pass-gate architecture of Jamshidi's two transistors would inherently be needed for blocking and enabling both lines of the hook state detection circuitry.

Once again, this rejection must fail because the premise upon which the motivation for the proposed combination lies is faulty. Once again, the addition of Scott as well as the addition of Jamshidi is based on the proposition that it would be obvious to a person skilled in the art to multiplex the input of the comparator. However, as discussed above in connection with claims 7 and 12, this does not make any sense because the comparator cannot reasonably function as an A/D converter with any secondary purpose in Scott or Jamshidi. Thus, it would not make any sense to multiplex it so that it can be used for purposes for which it is unsuited.

Independent claim 23 recites essentially the same limitations discussed above in connection with claim 19. Therefore, claim 23 also distinguishes over the prior art of record for the reasons discussed above in connection with claim 19.

Finally, claims 20-22 depend from claim 19 and claims 24-26 depend from claim 23. Accordingly, they distinguish over the prior art of record of record for the same reasons.

Applicant also has herein entered minor form amendments to the specification to correct inconsistencies between the reference numerals in the drawings and the specification and to change ownership entity information in connection with reference to a device available on the market. Those changes should be self-explanatory.

In view of the foregoing amendments and remarks, this application is now in condition for allowance. Applicant respectfully requests the Examiner to issue a Notice of Allowance at the earliest date. The Examiner is invited to contact Applicant's undersigned counsel by telephone call in order to further the prosecution of this case in any way.

Respectfully submitted,

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Dated

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